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Peripartum Depression and Contributing Factors: An Observational Study

Peripartum Depresyon ve Etki Eden Faktörler: Bir Gözlemsel Çalışma

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ÖZ

Amaç: Peripartum depresyon (PD) yaygın bir halk sağlığı sorunudur. Zamanında tanı ve tedavi çok önemlidir ve sağlık hizmeti sağlayıcılarının dikkatli bir şekilde ilgilenmesini gerektirir. Bu çalışma, Edinburgh Doğum Sonrası Depresyon Ölçeği'ni (EPDS) kullanarak peripartum depresyon riskiyle ilişkili demografik, klinik ve laboratuvar faktörlerini belirlemeyi amaçlamaktadır. Gereç ve Yöntem: Üniversite hastanemizin kadın doğum servis ve ayakta tedavi polikliniklerinden toplam iki yüz yirmi dokuz gebe ve doğum sonrası olgu, peripartum depresyon gelişme riskini ve katkıda bulunan faktörleri değerlendirmek için çalışmaya alındı. Demografik ve klinik özellikler, belirlenen laboratuvar değerleriyle (hemoglobin, tiroid hormonları ve D vitamini düzeyleri) birlikte analiz edildi. Bulgular: iki yüz yirmi dokuz olgu arasında (137 gebe, 92 doğum sonrası), %30,1'inin Edinburgh Doğum Sonrası Depresyon Ölçeği puanları anormal (13 ve üzeri) idi. İstatistiksel analiz, maternal obstetrik risk faktörlerinin, fetal ve neonatal sağlık sorunlarının ve düşük D vitamini düzeylerinin perinatal depresyon riskinin artmasıyla önemli ölçüde ilişkili olduğunu gösterdi. Sonuçlar: EPDS, yoğun kadın doğum servis ve polikliniklerinde peripartum depresyon riskini taramak için pratik bir araçtır. Obstetrik anne sağlık sorunları, fetal veya neonatal sağlık sorunları ve düşük D vitamini seviyeleri daha yüksek PD riskine katkıda bulunabilir. Bu risk faktörlerine sahip hamile veya lohusa kadınlar peripartum depresyonuna ilerlemesi açısından yakından izlenmeli ve endike olduğunda bir psikiyatri uzmanına yönlendirilmelidir.

Anahtar Kelimeler: *Perinatal depresyon, Doğum sonrası, Gebelik, Depresyon, D vitamini*

ABSTRACT

Objective: Peripartum depression (PD) is a common public health problem. Timely diagnosis and management are crucial and require careful attention from healthcare providers. This study aims to identify demographic, clinical, and laboratory factors associated with PD risk using the Edinburgh Postnatal Depression Scale (EPDS). Materials and Methods: A total of two hundred and twenty-nine pregnant and postpartum subjects were recruited from our university hospital's inpatient and outpatient clinics to evaluate peripartum depression development risk and contributing factors. Demographic and clinical characteristics, along with certain laboratory values (hemoglobin, thyroid hormones, and vitamin D levels) were analyzed. Results: Among the 229 subjects (137 pregnant, 92 postpartum), 30.1% had abnormal EPDS scores (≥13). Statistical analysis showed that maternal obstetric risk factors, fetal and neonatal health issues, and low vitamin D levels were significantly associated with an increased risk of perinatal depression. Conclusions: EPDS is a practical tool for screening PD risk in busy obstetrics inpatient and outpatient settings. Obstetric maternal health issues, fetal or neonatal health problems, and low vitamin D levels may contribute to a higher risk of PD. Pregnant or postpartum women with these risk factors should be closely monitored for PD progression and referred to a psychiatric professional when indicated.

Keywords: *Perinatal depression, Postnatal, Pregnancy, Depression, Vitamin D*

INTRODUCTION

Perinatal or peripartum depression (PD), formerly known as postnatal depression, is a significant healthcare concern. The prevalence of PD varies from 9% to almost 40%, depending on the region sampled (1-3). Limited studies in Turkey have reported prevalence rates ranging from 14% to 41% (4-8). As expected, demographic and economic factors as well as the population sampled (antepartum /postpartum, inpatient/outpatient settings) contribute to these variations.

The latest edition of the DSM-5, published by the American Psychiatry Association, includes a "peripartum onset" specifier for diagnosing peripartum depression, covering episodes that occur in pregnancy and within four weeks after delivery (9). The World Health Organization (WHO), in the “International Classification of Diseases – 10th Revision” (ICD-10), defines postpartum depression as episodes occurring within six weeks of delivery (10). Nevertheless, studies suggest that the prevalence of antepartum and postpartum onset is similar (11).

PD affects not only pregnant and postpartum patients but also the long-term health of their newborns, as an increasing number of studies suggest lingering effects. These effects can be psychological (e.g., anxiety, depression, and behavioral issues) as well as physical (e.g., an increased incidence of asthma, diabetes, and intestinal problems) (12-14). Screening for PD can be conducted using one of several available questionnaires. Edinburgh Postnatal Depression Scale (EPDS) is a practical tool that can be used in busy clinical settings to screen not only postpartum but also antenatal patients for PD risk (15,16). EPDS has been validated in Turkish (17). However, a definitive diagnosis of PD can only be made through face-to-face psychiatric evaluations.

The exact cause of PD remains unknown, but several factors including genetics, hormonal and nutrient imbalances, low socioeconomic status, pregnancy complications, and fetal or newborn health problems have been linked to its development. A prior history of depression is widely recognized as a major risk factor for PD (3,18).

The objective of this study was to assess the risk factors associated with the development of PD in both pregnant and postpartum individuals. Therefore, we conducted this study at our university hospital's outpatient and inpatient clinics to identify demographic, clinical, and laboratory factors related to the development of PD.

MATERIAL and METHOD

This was a prospective observational study conducted at Aydin Adnan Menderes University Hospital’s Obstetrics and Gynecology inpatient and outpatient clinics. The hospital is located in Aydin Province in Turkey with a population of 260,000. Ethical approval from the Institution’s Review Board has been obtained before the beginning of the study (Aydin Adnan Menderes University Ethical Board for Non-Invasive Clinical Research, Decision Number 12, Protocol Number 1024/152, and Date of 29/11/2024). The study was conducted by the principles of the "Helsinki Declaration".

The inclusion criteria required participants to be either pregnant or within the puerperium period (the first six weeks postpartum), have proficiency in speaking and understanding Turkish, and provide consent to participate. The exclusion criteria included the following: lack of consent to participate, a previous diagnosis of anxiety or psychiatric disorders, and inability to speak or understand the Turkish language.

Both antepartum and postpartum subjects were approached in the obstetrics and gynecology outpatient clinic. Several subjects were also recruited from inpatient labor and delivery services during their hospital stay for labor or pregnancy issues such as preterm labor or diabetes management. Subjects were asked a standard set of questions regarding their demographic and clinical information. The information form consisted of 24 questions about their age, marital status, gestational status, intended/unintended pregnancy, social support system, smoking status, systemic

disease history, prenatal care status (including obstetric complications, and fetal anomalies), mode of delivery, and the need for neonatal intensive care (NICU) after delivery. Adverse situations and pregnancy complications were later classified under "maternal factors" such as gestational diabetes, abruptio placenta, preterm premature membrane rupture, and oligo/polyhydramnios. Problems and complications regarding the fetus were named under "fetal factors" such as fetal anomaly on antenatal ultrasound, karyotype abnormality, and twin complications.

For PD risk assessment, the Edinburgh Postnatal Depression Scale (EPDS) was used. EPDS is a self-administered questionnaire used to screen both antepartum and postpartum women for PD risk. It consists of 10 multiple-choice questions regarding sleep, anxiety, sadness, and suicidal tendencies. Each choice equals 0 - 3 points (minimum 0, maximum 30 points). The total score is calculated at the end. The cut-off value for "high risk for depression status" is 13 points, although different cut-off points have been used resulting in different sensitivity and specificity levels (19, 20). EPDS has already been validated for use in Turkish (17).

Recent hemoglobin (Hgb), thyroid-stimulating hormone (TSH), and serum vitamin D levels were obtained from health records within one month of EPDS questionnaire administration to assess anemia, thyroid disease, and vitamin D deficiency, respectively.

Sample Size and Power

A sample size of at least 219 subjects was calculated to achieve 80% power with a 5% margin of error and 95% confidence interval. Following data collection, EPDS scores were examined for potential correlations with patient characteristics and clinical/laboratory data using NCSS 2020 software (NCSS LLC, Kaysville, Utah, USA). Descriptive statistics were presented, and data conformity to normal distribution was analyzed using the Shapiro-Wilk test. Student's t-test was used for normally distributed variables, one-way ANOVA test was used for three-group differences. The Mann-Whitney U and Kruskal-Wallis tests were used for variables that were not normally distributed. The effects of independent variables were analyzed by using regression models. Analyses were evaluated in 95% CI and $p<0.05$ level of significance.

RESULTS

A total of 229 subjects were recruited during the designated study period. Among these, 137 (59.8%) were pregnant and 92 (40.2%) were postpartum subjects (Table 1). The pregnant group was divided into early pregnancy (<28 weeks, n = 64) and late pregnancy (>28 weeks, n = 73) subgroups for further analysis. Descriptive statistics for demographic and clinical data were given in Table 1, such as gravida, parity, marital status, smoking, systemic disease, singleton/multifetal pregnancy, presence of support system, intended/unintended pregnancy, maternal obstetric factors (gestational diabetes, hypertension, etc.), presence of fetal factors (fetal anomalies, twin complications, etc.) and neonatal intensive care (NICU) admissions for postpartum subjects. Mean EPDS scores and laboratory values (hemoglobin, vitamin D, and TSH) were also provided in Table 1. No correlation was identified between EPDS scores and hemoglobin levels.

The mean age of the participants was 29.5±5.9 years for the whole group and 28.9±5.9 years for the pregnancy group. Mean age was slightly higher in the postpartum group than in the late pregnancy group (30.6±5.7 vs 28.8±5.7, respectively, $p = 0.04$).

Subjects with fetal factors were more common in the postpartum group than in early ($p = 0.03$) and late pregnancy groups ($p = 0.04$). Similarly, maternal factors were more common in the postpartum group than pregnancy groups ($p = 0.02$ for early and $p = 0.05$ for late pregnancy group). The postpartum group had lower vitamin D levels than the late-pregnancy group ($p = 0.05$).

Table 1: Demographic and Clinical Data of the Study Population

	Pregnant total(n=137)	Pregnant ≤28 (n=64)	Pregnant >28 (n=73)	Postpartum (n=92)	Total (n=229)
Age, years (mean±SD)	28.9(±5.9)	29.0(±6.1)	28.8(±5.7)	30.6 (± 5.7)	29.5±5.9
Marital status, married, n(%)	135(98.5%)	63(98.4)	72(98.6)	91(98.9)	226(98.6)
Smoking status, yes, n(%)	16(11.7)	9(14.1)	7(9.6)	12(13.0)	28(12.2)
Systemic disease yes, n(%)	53(38.7)	22(34.4)	31(42.5)	33(35.9)	86(37.5)
Pregnancy Related Variables					
Previous Pregnancies					
Nullipara, n (%)	71(51.8)	35(54.7)	26(35.6)	9(9.8)	80(34.9)
Previous CS, n (%)	43(31.4)	23(35.9)	21(28.8)	64(69.6)	107(46.7)
Previous VD, n (%)	24(17.5)	10(15.6)	14(19.2)	11(12.0)	35(15.3)
Previous CS and VD), n(%)	7 (5.1)	2 (3.1)	5 (6.8)	8 (8.7)	15 (6.6)
Intended pregnancy, yes n(%)	103(75.2)	49(76.7)	54(74.0)	63(68.5)	166(72.5)
Singleton, n(%)	128(93.4)	60(93.8)	68(93.2)	86(93.5)	214(93.4)
Multifetal, n(%)	9(6.6)	4(6.3)	5(6.9)	6(6.5)	15(6.6)
Gravida, IR/(Min-Max)	3-7 (1-9)	3-7 (1-8)	3-7 (1-9)	3-7(1-9)	3-7(1-9)
Parity, IR/(Min-Max)	1-3(0-5)	1-3(0-5)	1-3(0-3)	1-3(0-5)	1-3 (0-5)
Alive child, IR/(Min-Max)	1-3(0-5)	1-3 (0-5)	1-3 (0-3)	1-3 (0-5)	1-3 (0-5)
Fetal Factors*, yes n(%)	15 (6.9)	6 (9.4)	9 (12.3)	19 (20.6)	34 (14.8)
Maternal Factors** , yes n(%)	77 (57.7)	35 (54.7)	42 (57.5)	70 (76.1)	147 (64.2)
Newborn NICU admission- yes, n (%)				35 (38.1)	
Neonatal health problem -yes ***n (%)				70 (76.1)	
Postnatal social support system, yes, n (%)				88 (95.7)	
EPDS scores and Laboratory variables					Total
EPDS score, Average (Min-Max)	7.0(0-19.0)	7.6(0-19.0)	6.9(0-17.0)	8.0(0-22)	7.6(0-22)
Vitamin D level, ng/ml) Average, (Min-Max)	16.5(4.9-54.0)	17(5-37)	15.9(4.9-54)	15.8(2.7-43)	16.3(2.7-54)
Hgb level, (g/dl) Average, (Min-Max)	11.1(8.0-17.1)	11.3 (8.0-14.2)	10.9(8-17.1)	10.1(7.5-14.2)	10.9(7.5-17.1)
TFT- hypothyroidism, Yes n(%)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)

EPDS: Edinburgh Postnatal Depression Scale, CS: Cesarean section, VD: Vaginal delivery, SD: Standard deviation NICU: Neonatal Intensive Care Unit, TFT: Thyroid function tests, Hgb: hemoglobin, IR: Interquartile range, 25-75%. *Fetal Factors: intrauterine growth retardation (IUGR): 4 cases. Congenital pulmonary adenoid malformation: 1 case. IUGR and delX chromosome: 1 case, trisomy 21: 1 case, monochorionicity: 1 case. **Maternal Factors: GDMA1: Gestational diabetes A1, GDMA2: Gestational diabetes A2. IUGR, oligohydramnios, abruptio placenta, intrahepatic cholestasis, hydronephrosis, co-twin in-utero ex, preterm membrane rupture.***Neonatal health problems: neonatal tachypnea: 2 cases, hypoglycemia: 3 cases, jaundice: 1 case, prematurity: 14 cases, microcephaly and duodenal atresia: 1 case, tricuspid regurgitation and ventricular septal defect: 1 case, hypoglycemia and respiratory distress syndrome (RDS): 1 case, hydrocephalus: 1 case, ventricular septal defect: 1 case, prematurity and RDS: 1 case.

EPDS Scores (above vs under the cut-off value)
In the whole study population (229 subjects), 30.1% of patients had abnormal (at or above the cut-off value of 13) EPDS scores (Table 2). Subjects with abnormal EPDS scores had a lower mean gestational age (27.7 weeks vs 25.9 weeks, p = 0.02), but a higher percentage of fetal and maternal factors (p = 0.03 and p = 0.02) (Table 3). Also, vitamin D levels were found to be significantly lower in the abnormal EPDS score group (15.9±7.7 ng/ml, p = 0.02). There were no other statistically significant differences between normal and abnormal EPDS score groups (Table 3).

Table 2: EPDS Scores and Study Population

Category	Pregnant ≤28w (n=63)	Pregnant >28w (n=73)	Postpartum (n=93)	Total (n=229)
EPDS Score 1-12, n (%)	43 (68.3)	54 (74.0)	63 (67.7)	160 (69.9)
EPDS Score ≥13, n (%)	20 (31.7)	19 (26.0)	30 (32.3)	69 (30.1)

EPDS: Edinburgh Postnatal Depression Scale, w: weeks

Table 3: Comparison of Demographic/Clinic and Laboratory Characteristics by EPDS Cut-Off Value

Category	EPDS Score 0-12 (n=160)	EPDS Score ≥13 (n=69)	p value
Age, years, mean (±SD)	28.8±5.7	29.0±5.7	1.56
Marital status – married (%)	150(%)	51(%)	1.97
Smoker – Yes, n(%)	34(19.2)	12(23.1)	0.12
Gestational weeks, mean(±SD)	27.9±8.6	24.8±7.1	0.02
Intended pregnancy, Yes, n(%)	103(75.2)	63(68.5)	0.06
Singleton, yes n(%)	172(97)	49(93.5)	0.09
Fetal Factors, Yes, n(%)	22(13.0)	13(26.9)	0.03
Maternal Factors, Yes, n(%)	108(61.0)	40(76.9)	0.02
Laboratory findings			
Vitamin D level (ng/ml)	17.0±7.6	15.9±7.7	0.02
Hgb level (g/dl)	10.4±1.8	10.4±1.5	1.83

Student's t-test, Chi-square test. EPDS: Edinburgh Postnatal Depression Scale, SD: standard deviation, Hgb:Hemoglobin

Subgroups and EPDS Scores

In subgroup analysis, the abnormal EPDS score frequency was 31.7% in the early pregnancy group, 26% in the late pregnancy group, and 32.3% in the postpartum group (Table 2). Demographic variables were not different among groups based on normal and abnormal EPDS scores. EPDS scores were significantly higher in the postpartum group compared to the late-pregnancy group (p = 0.05). Also, vitamin D levels were significantly lower in the postpartum group than in the early pregnancy group (p = 0.05).

Table 4: Subgroup Demographic and Clinical Data Comparison

Parameter	Pregnancy ≤28w – Pregnancy >28w	Postpartum – Pregnancy ≤28w	Postpartum – Pregnancy >28w	Postpartum – Pregnancy
Demographic and clinical characteristics				
Age	p = 0.05	p = 0.14	p = 0.04	p = 0.03
Marital status, married	p = 0.15	p = 0.24	p = 0.17	p = 0.23
Smoker, yes	p = 0.13	p = 0.10	p = 0.02	p = 0.14
Systemic Disease	p = 0.25	p = 0.18	p = 0.30	p = 0.10
Obstetric characteristics				
Nulliparity	p = 1.92	p = 0.17	p = 1.12	p = 1.31
Previous CS	p = 1.36	p = 1.41	p = 1.37	p = 1.23
Previous VD	p = 0.67	p = 1.32	p = 0.54	p = 1.09
Previous CS and VD	p = 1.31	p = 1.85	p = 1.37	p = 1.52
Intended pregnancy	p = 0.14	p = 0.09	p = 0.08	p = 0.09
Singleton	p = 0.18	p = 0.09	p = 0.07	p = 0.09
Gravida	p = 0.12	p = 0.09	p = 0.08	p = 0.12
Parity	p = 0.06	p = 0.17	p = 0.11	p = 0.07
Alive children	p = 0.17	p = 0.12	p = 0.13	p = 0.12
EPDS Score and Laboratory Variables				
EPDS Score	p = 0.13	p = 0.21	p = 0.05	p = 0.22
Vitamin D level	p = 0.44	p = 0.05	p = 0.09	p = 0.18
Hemoglobin level	p = 0.25	p = 0.18	p = 0.08	p = 0.07

T-Test (Parametric), Mann-Whitney U Test (Non-parametric, two groups), Chi-square Test (categoric), Fisher's Exact Test, statistical significance level p<0.05. EPDS: Edinburgh Postnatal Depression Scale, CS: cesarean section, VD: vaginal delivery

Regression Analyses EPDS Scores (No Cut-off Value)

Association between EPDS scores and independent variables evaluated for their effect by multivariate regression analysis. Maternal and fetal factors were significantly related to EPDS scores (β= 2.40, p<0.00 and β= 3.5, p<0.00 respectively). Also, smoking and low vitamin D levels were significantly associated with higher EPDS scores (β= 0.92, p = 0.05 and β= -0.08, p = 0.05, respectively) (Supplementary Table 1).

Regression Analyses of EPDS Scores (by Cut-off Value)

When abnormal EPDS scores (above cut-off value) and other variables were investigated, a binary logistic regression analysis revealed that fetal factors (OR = 0.85, p = 0.04), maternal factors (OR = 2.40, p = 0.05), higher gravida (OR = 1.31, p = 0.03) and low vitamin D level (OR=0.98, p=0.05) were significantly associated with abnormal EPDS scores (Supplementary Table 2).

Correlation Analyses

EPDS scores and other variables were compared by using Pearson/Spearman correlation analysis. Fetal factor history had a strong positive correlation and vitamin D levels had a strong negative correlation with EPDS scores (without cut-off value) ($r=0.65$, $p<0.001$ and $r=-0.61$, $p<0.001$). Other variables with weak or no correlation to EPDS scores were also provided (Supplementary Table 3).

DISCUSSION

Peripartum Depression (PD) represents a critical healthcare issue impacting women of reproductive age as well as their newborns. The substantial physiological changes and hormonal fluctuations that occur during pregnancy and the puerperium phase elevate the risk of depression. Undiagnosed PD can lead to unfavorable outcomes. Women with PD are at risk for major depression, suicide, and harming their baby (21). Antenatal onset of depression may also have negative effects on fetal neural development (22).

Several risk factors for PD development have been proposed aside from hormonal changes. A prior depression diagnosis in the past is considered a major risk factor. Additional risk factors include young or advanced maternal age, low socioeconomic status, unintended pregnancy, multiparity, pregnancy complications, anemia, vitamin D deficiency, and maternal distress related to obstetric or newborn health issues (12, 23-25).

EPDS is widely used to screen both pregnant and postpartum women at risk for developing PD (15). Nevertheless, there are other alternatives such as Beck Depression Inventory, Patient Health Questionnaire 9, and Zung Self-Rating Depression Scale. All these screening approaches have sensitivity and specificity levels ranging between 50-100% (19,20,23). Increasing a test's sensitivity by asking more questions is possible but limiting the number of questions makes it practical for use in busy healthcare settings. EPDS is useful both in the antepartum and postnatal period for PD screening (16). However, it must be emphasized that the EPDS is used for screening purposes, not for final PD diagnosis. High scores should lead to a referral for psychiatric evaluation of the patient. In this study, we aimed to include both postpartum and pregnant subjects because PD symptoms can also be observed during pregnancy, and early intervention is important. The mean age of the pregnancy group was 28.9±5.9 years. No significant association was identified between abnormal EPDS scores and the mean age variable, despite some studies indicating that both younger and older ages could be associated with an increased risk of PD (26,27).

Some observations suggest that being married may reduce the risk of PD (28); however, in our study, 98.5% of participants were married, making it difficult to assess the relationship between depression risk and marital status.

In this study, a higher gravida number was identified as being associated with abnormal EPDS scores through logistic regression analysis ($OR=1.31$, $p = 0.03$, data not shown). Several pieces of evidence in the literature support the association between higher gravida numbers and an increased risk of postpartum depression (29).

Smoking during pregnancy is also suggested as a possible risk factor for PD (30). Our results revealed a weak positive correlation between smoking status and linear EPDS scores ($r=0.19$, $p = 0.05$, Supplementary Table 3). Systemic (chronic) disease history was not associated with increased PD risk in our study. However, previous research suggested an elevated PD risk in women with a history of systemic disease (31). It is possible that other factors may influence this potential risk factor. We could not interpret the variable thyroid hormone levels for PD risk due to an insufficient number of subjects with abnormal levels. Unintended pregnancies were pointed out as an additional stress factor for PD development (32). Our results showed no relationship between the intended/unintended pregnancy variable and abnormal EPDS scores. Likewise, no associations were

observed between multifetal pregnancy, singleton pregnancy, parity number, previous mode of delivery, hemoglobin levels, and abnormal EPDS scores.

Approximately thirty percent (30.1%) of the whole study population had abnormal EPDS scores. It was 28.6% in the pregnancy group and 32.3% in the postpartum group (Table 2). The observed frequencies align with previous findings, indicating that PD is not uncommon during the antenatal period. Therefore, it is essential that screening for postpartum depression (PD) is not limited solely to postpartum patients.

Maternal and fetal factors were significantly higher in the abnormal EPDS score group (Table 1). It can be inferred that fetal and maternal factors can be a source of significant distress. These may include any diagnoses or findings related to pregnancy, such as gestational diabetes, preterm labor, placental issues, amniotic fluid volume abnormalities, complications specific to twin pregnancies, fetal growth restriction, and fetal anomalies. Many studies in the literature have reported maternal and/or fetal issues that elevate the risk of PD (33). Hence, patients with maternal obstetric problems and/or fetal issues may warrant screening for PD.

In this study, serum vitamin D levels were significantly lower in the group with abnormal EPDS scores. A strong negative correlation was observed between serum vitamin D levels and EPDS scores ($r=-0.61$, $p<0.001$, Supplementary Table 3). Vitamin D is a molecule with immunomodulator and anti-inflammatory properties. Recent studies indicate that low vitamin D levels during pregnancy and postnatal periods may be linked to PD, though the exact mechanism remains unknown (34). However, whether vitamin D supplementation would improve the EPDS scores is not clear (35). Although controversial, vitamin D level measurement during pregnancy and supplementing the subjects with low levels may be warranted.

Limitations

The study's limitations included omitting socioeconomic statuses, a low number of postpartum subjects, and heterogeneity of the groups in terms of inpatient/outpatient recruitment. The strengths of this study included power size calculation, a relatively low migrant population in the area (homogeneous population), and coverage of both prenatal and postnatal subjects while investigating vitamin D levels. Future research should explore whether interventions such as vitamin D supplementation or targeted support for women facing obstetric complications can effectively reduce PD risk.

CONCLUSION

Our study found that higher gravida numbers, the presence of maternal and fetal factors, and low serum vitamin D levels were significantly associated with elevated EPDS scores. Although other factors such as systemic disease history and thyroid hormone levels were examined, only the aforementioned variables demonstrated statistically significant correlations with PD risk.

This prospective observational study indicates that low vitamin D levels, the presence of obstetric or fetal health issues, and high parity are significantly associated with an increased risk of peripartum depression, as reflected by elevated EPDS scores. These findings underscore the importance of implementing routine PD screening for both pregnant and postpartum women, particularly among those with identified risk factors.

Ethical Approval: Ethical approval from the Institution's Review Board has been obtained prior to the beginning of the study (Aydin Adnan Menderes University Ethical Board for Non-Invasive Clinical Research, Decision number 12, Protocol number 1024/152, and date of 29/11/2024). The study was conducted in line with the principles of the "Helsinki Declaration". Written informed consent to participate and publish was obtained from all individual participants or legal guardians included in the study.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Authors Contributions: EZ: Conceptualization, data curation, formal analysis, project administration, investigation, methodology, validation, writing-original draft.
TYO: Formal analysis, investigation, methodology, resources, supervision, validation, writing-review & editing.
SKE: Investigation, validation, Formal analysis, investigation, editing.
NAS: Supervision, writing-review & editing.

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REFERENCES

1. MW, Wisner KL. Perinatal mental illness: definition, description, and etiology. Best Pract Res Clin Obstet Gynaecol. 2014 Jan;28(1):3-12.
2. Liu X, Wang S, Wang G. Prevalence and Risk Factors of Postpartum Depression in Women: A Systematic Review and Meta-analysis. J Clin Nurs. 2022;31(19-20):2665.
3. Vesga-López O, Blanco C, Keyes K, Olfson M, Grant BF, Hasin DS. Psychiatric disorders in pregnant and postpartum women in the United States. Arch Gen Psychiatry. 2008;65(7):805.
4. Yurdakul FE, Karataş Eray İ. The Relationship Between Mode of Delivery and Postpartum Depressive Symptoms in Women. Türk Aile Hek Derg 2024;28(2):55-62 doi:10.54308/tahd.2024.47965
5. Durukan E, İlhan M, Bumin MA, Aycan S. 2 Hafta-18 Aylık Bebeği Olan Annelerde Postpartum Depresyon Sıklığı ve Yaşam Kalitesi. Balkan Medical Journal. 2011;28:385-93. 5.
6. Inandi T, Bugdayci R, Dundar P, Sumer H, Sasmaz T. Risk factors for depression in the first postnatal year: a Turkish study. Soc Psychiatry Psychiatry Epidemiol. 2005;40(9):725-30. 6.
7. Danaci AE, Dinç G, Deveci A, Sen FS, Içelli I. Postnatal depression in Turkey: epidemiological and cultural aspects. Soc Psychiatry Psychiatr Epidemiol. 2002;37(3):125-9.
8. Tahaoğlu AE, Toğrul C, Külahçıoğlu Mİ. Diyarbakır'da postpartum depresyonu etkileyen faktörler. Perinatoloji Dergisi. 2015;23(1):26-9
9. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), American Psychiatric Association, Arlington, VA 2013.
10. World Health Organization. International Classification of Diseases (ICD) [Internet]. ICD-10 online version: 2016. [Accessed on 2025 Mar 7]. Accessed to: http://www.who.int/classifications/icd/en/
11. Fisher SD, Wisner KL, Clark CT, Sit DK, Luther JF, Wisniewski S. Factors associated with onset timing, symptoms, and severity of depression identified in the postpartum period. J Affect Disord. 2016;203:111.
12. O'Hara MW, McCabe JE. Postpartum depression: current status and future directions. Annu Rev Clin Psychol. 2013;9:379-407.
13. Stein A, Pearson RM, Goodman SH, Rapa E, Rahman A, McCallum M, et al. Effects of perinatal mental disorders on the fetus and child. Lancet. 2014;384(9956):1800.
14. Raposa E, Hammen C, Brennan P, Najman J. The long-term effects of maternal depression: early childhood physical health as a pathway to offspring depression. J Adolesc Health. 2014 Jan;54(1):88-93.
15. Cox JL, Holden JM, Sagovsky R. Detection of postnatal depression. Development of the 10-item Edinburgh Postnatal Depression Scale. Br J Psychiatry. 1987;150:782.
16. Rubertsson C, Börjesson K, Berglund A, Josefsson A, Sydsjö G. The Swedish validation of Edinburgh Postnatal Depression Scale (EPDS) during pregnancy. Nord J Psychiatry. 2011 Dec;65(6):414-8.
17. Aydin N, Inandi T, Yigit A, Sahin Hodoglugil NN. Validation of the Turkish version of the Edinburgh Postnatal Depression Scale among women within their first postpartum year. 2004 Jun;39(6):483-6. Soc Psychiatry Psychiatr Epidemiol. doi: 10.1007/s00127-004-0770-4.
18. Dietz PM, Williams SB, Callaghan WM, Bachman DJ, Whitlock EP, Hornbrook MC. Clinically identified maternal depression before, during, and after pregnancies ending in live births. Am J Psychiatry. 2007 Oct;164(10):1515-20.
19. Wisner KL, Sit DKY, McShea MC, Rizzo DM, Zoretich RA, Hughes CL, et al. Onset timing, thoughts of self-harm, and diagnoses in postpartum women with screen-positive depression findings. JAMA Psychiatry. 2013;70(5):490.
20. Levis B, Negeri Z, Sun Y, Depression Screening Data (DEPRESSD) EPDS Group. Accuracy of the Edinburgh Postnatal Depression Scale (EPDS) for screening to detect major depression among pregnant and postpartum women: systematic review and meta-analysis of individual participant data. BMJ. 2020;371:m4022.
21. Cantwell R, Clutton-Brock T, Cooper G, Dawson A, Drife J, Garrod D, et al. Saving Mothers' Lives: Reviewing maternal deaths to make motherhood safer: 2006-2008. The Eighth Report of the Confidential Enquiries into Maternal Deaths in the United Kingdom. BJOG. 2011 Mar:118 Suppl 1:1-203. doi: 10.1111/j.1471-0528.2010.02847.x.
22. Cattarinussi G, Aarabi MH, Sanjari Moghaddam H, Homayoun M, Ashrafi M, Soltanian-Zadeh H, et al. Effect of parental depressive symptoms on offspring's brain structure and function: A systematic review of neuroimaging studies. Neurosci Biobehav Rev. 2021;131:451.
23. ACOG Committee Opinion No. 757: Screening for Perinatal Depression. Obstetrics & Gynecology 132(5):p e208-e212, November 2018. | DOI: 10.1097/AOG.0000000000002927

24. Robinson M, Whitehouse AJ, Newnham J, Gorman S, Jacoby P, Holt BJ, et al. Low maternal serum vitamin D during pregnancy and the risk for postpartum depression symptoms. Archives of Women's Mental Health. 2014;17:213-9.
25. Kınık E, Özcan H. Comparison of Health Practices and Depression in Planned and Unplanned Pregnancies. Ankara Sağlık Bilimleri Dergisi. 2024;13(2):94-102.
26. Goodman JH. Postpartum depression beyond the early postpartum period. Journal of Obstetric, Gynecologic, & Neonatal Nursing. 2004;33(4):410-20.
27. Tang X, Lu Z, Hu D, Zhong X. Influencing factors for prenatal stress, anxiety and depression in early pregnancy among women in Chongqing, China. Journal of Affective Disorders. 2019;253:292-302.
28. Elsenbruch S, Benson S, Rücke M, Rose M, Dudenhausen J, Pincus-Knackstedt MK et al. Social support during pregnancy: effects on maternal depressive symptoms, smoking, and pregnancy outcome. Human reproduction. 2007;22(3):869-77.
29. Nwafor CE, Ojiako A, Ugwu PC. Impact of Gravida and Level of Psycho-Education on Antenatal Anxiety. Social Science Research. 2024;10(3).
30. Smedberg J, Lupattelli A, Mårdby A-C, Øverland S, Nordeng H. The relationship between maternal depression and smoking cessation during pregnancy—a cross-sectional study of pregnant women from 15 European countries. Archives of Women's Mental Health. 2015;18:73-84.
31. Sundström Poromaa I, Comasco E, Georgakis MK, Skalkidou A. Sex differences in depression during pregnancy and the postpartum period. Journal of neuroscience research. 2017;95(1-2):719-30.
32. Becker M, Weinberger T, Chandy A, Schmukler S. Depression during pregnancy and postpartum. Current psychiatry reports. 2016;18:1-9.
33. Bansil P, Kuklina EV, Meikle SF, Posner SF, Kourtis AP, Ellington SR, et al. Maternal and fetal outcomes among women with depression. Journal of Women's Health. 2010;19(2):329-34.
34. Huang JY, Arnold D, Qiu CF, Miller RS, Williams MA, Enquobahrie DA, et al. Association of serum vitamin D with symptoms of depression and anxiety in early pregnancy. Journal of women's health. 2014;23(7):588-95.
35. Vaziri F, Nasiri S, Tavana Z, Dabbaghmanesh MH, Sharif F, Jafari P, et al. A randomized controlled trial of vitamin D supplementation on perinatal depression: in Iranian pregnant mothers. BMC pregnancy and childbirth. 2016;16:1-12.